

REMARKS/ARGUMENTS

In the Office Action mailed on 16 March 2007, the Examiner rejected claims 1-8, 10-11, and 13-32. Claims 9, 12, and 33-36 had previously been canceled, and claims 1-8, 10-11, and 13-32 are presently under consideration. Applicant has amended claim 1. Applicant respectfully requests reconsideration of the application by the Examiner in light of the above amendments and the following remarks.

35 USC 112

Applicant respectfully traverses the rejection of claims 1-8, 10-11, and 13-32 under 35 USC 112, second paragraph.

Claim 1 (as amended) recites:

1. A method of forming a waveguide comprising a core region, a cladding region, and an index contrast region situated therebetween, the method comprising:
depositing a polymerizable composite on a substrate to form a layer, wherein the polymerizable composite comprises a polymer binder and an uncured monomer,
patterning the layer to define an exposed area and an unexposed area of the layer in a manner such that the unexposed area includes the core region,
irradiating the exposed area of the layer to polymerize the polymerizable composite in the exposed area, and
volatilizing the uncured monomer in the unexposed area by baking and **by diffusing some uncured monomer from the unexposed area towards the exposed area** to form the index contrast region of the waveguide.

The Office Action appears to object to the bolded language of claim 1 and similar language of claim 16 and states "this diffusion is not necessarily linked to the volatilizing as is now apparently claimed. Applicant needs to provide direct support for this or explain how the amended language is not new matter."

Applicant respectfully submits that the link is inherent and clear. For example, see paragraph 8 as originally filed:

[0008] Briefly, in accordance with one embodiment of the present invention, a method of forming a waveguide comprising a core region, a cladding region, and an index contrast region situated therebetween comprises: depositing a polymerizable composite on a substrate to form a layer, patterning the layer to define an exposed area and an unexposed area of the layer, irradiating the exposed area of the layer, and **volatilizing the uncured monomer to form the waveguide**, wherein the **polymerizable composite comprises a polymer binder and sufficient quantities of an uncured monomer to diffuse into the exposed area of the layer and form the index contrast region**.

As another even more specific example providing support for the claim 1 language, please see paragraphs 47 and 48 as originally filed:

[0047] FIG. 8 is a side view illustrating **baking and diffusion (hereinafter also referred to as "volatilizing") of uncured monomer from an area of the layer that is not exposed to irradiation** (shown as unexposed area 28), and FIGS. 9-11 are view illustrative of the waveguide, cladding, and index contrast regions after the diffusion step of the embodiment of FIG. 8 (and addition of a top cladding layer 30) along with corresponding index and height profiles. Top and bottom cladding layers typically comprise materials such as optical polymer, sol gel (a colloidal suspension of silica particles that is gelled to form a solid), low-temperature grown inorganic crystals, or semiconductors, for example.

[0048] **During diffusion, uncured monomers from unexposed area 28 diffuse both vertically (and are evaporated) and laterally into exposed area 26** (the catalysts activated area) where the monomers are polymerized, enhancing the amount of low RI composition in the cladding beyond what was initially added into the composite blend. By appropriate selection of the chemical composition of monomer/polymer blend (percent and ratio), the structure and geometry of waveguide (thickness, width, spacing), and the conditions used during processing (post bake, atmosphere or vacuum), enhancement of low index monomer content into the side cladding, and thus **enhancement of the index contrast**, can exceed about twenty percent.

Therefore, Applicant respectfully submits that claims 1-8, 10-11, and 13-32 are in full compliance with the requirements of 35 USC 112, second paragraph.

35 USC 103

Applicant respectfully traverses the rejection of claims 1-8, 10-11, and 13-32 under 35 USC 103(a) over Suzuki US4877717 or Chandross US3809732 in view of Nishimura US6828078. Applicant has added the "by baking" language to claim 1. Support can be found in the above-quoted paragraph 47 of Applicant's Specification, for example.

With respect to Chandross, the Office Action states:

... Applicant is referred to Figures 2C and 2D of Chandross et al, which clearly shows that the monomer is diffused from the unexposed area to the exposed area during the irradiation. This is submitted to be true since the overall layer 22 initially has a uniform concentration of the monomer. Upon irradiation, a concentration gradient exists with the concentration being much higher at the exposed (ie, raised) area, a little less at the adjacent areas (which would constitute the diffusion source and index contrast regions) and less still in the unexposed areas. It is clear that a diffusion of the polymerizable monomer has occurred.

Chandross exposes the area to form the core as can be seen from FIGs. 2C and 2D and from column 2 lines 48-56 which discuss using the exposure to lock in the dopant; column 2, lines 56-60 which reference then removing the dopant from the unexposed areas; and column 4, lines 28-33 which reference writing of an optical circuit pattern using a focused beam of radiation.

Chandross does not disclose "volatilizing the uncured monomer in the unexposed area by diffusing some uncured monomer from the unexposed area towards the exposed area to form the index contrast region of the waveguide" (claim 1) or "volatilizing the uncured monomer in the core and diffusion source regions to diffuse some uncured monomer from the unexposed

area towards the exposed area and form the index contrast region of the waveguide" (claim 16). In Chandross, the structure is heated to evaporate unexposed dopant, and neither diffusion nor an index contrast region appear to be addressed as can be seen from, for example, column 5, lines 42-52:

The final step in the flow chart of FIG. 1 involves the development of the exposed circuit pattern in film 22. Development is carried out by simple heating of the film to evaporate the unexposed portion of the dopant. This step leaves the exposed portions of the dopant in position in the film and has two consequences: first, the refractive index of the exposed portions of film 22 is intermediate between that of the original poly and that of the dopant material itself; and, secondly, the thickness of film 22 is reduced in the unexposed regions thereof due to removal of the unexposed dopant. A structure of the type illustrated in FIG. 2D of the drawing results.

With respect to Suzuki, the Office Action States:

Suzuki et al is applied to teach basically the same process. Both primary references heat the film to volatilize uncured monomer, and the processes taught therein would be inclusive of the original recitations of volatilizing the uncured monomer and forming the waveguide.

Applicant respectfully submits that Suzuki does not teach or disclose the claim 1 recitations that are discussed above in with respect to Chandross. Like Chandross, Suzuki exposes the area to form the core. This is most easily seen in Suzuki FIG. 24 and column 18, lines 33 through 49, as well as column 7, line 58.

With respect to claim 1, Suzuki also does not appear to describe volatilizing by baking and diffusing. Suzuki column 18, lines 16-59 state:

The above-described formation of the optical elements will be further described with reference to FIGS. 20A and 20B. A light-sensitive film 52 is positioned on the substrate 51 and consists of photo-reactive compounds M, compounds N capable of being absorbed by the reaction products P of the compounds M (compounds N may be the same or different from the compounds M), and binding polymers BP.

As illustrated in FIG. 20A selective exposure of the film 52 is carried out through a photomask 53. During this exposure, reaction products P of the compounds M are produced in the exposed area 55. These reaction products P absorb the compounds M and/or N contained in the exposed area and swell. Then, the absorbed compounds M further produce reaction products P. These new reaction products P absorb the compounds M and/or N diffused from the unexposed area 56 and swell. The exposed area 55 containing the reaction products P therefore continues to swell, so long as the compounds M and/or N are supplied to that area. FIG. 20B shows the results of the formation process according to the described embodiment. Type of gradient thickness films which are possible include a diffraction grating, as illustrated in FIG. 23, and an optical waveguide, as illustrated in FIG. 24.

According to the present invention, a large variation in the form of the light-sensitive film can be obtained because the expansion of the exposed area of the film is induced by the irradiation of radiation. Further, if an outer force such as gravity does not affect the system, the expansion of the exposed area will be continued until the photoreactive compounds in the film are exhausted. Accordingly, optical elements such as gradient thickness films having a remarkably varied film form can be obtained.

Although some polymerization is indicated to continue to occur after the irradiation, no combination of baking and diffusing is described.

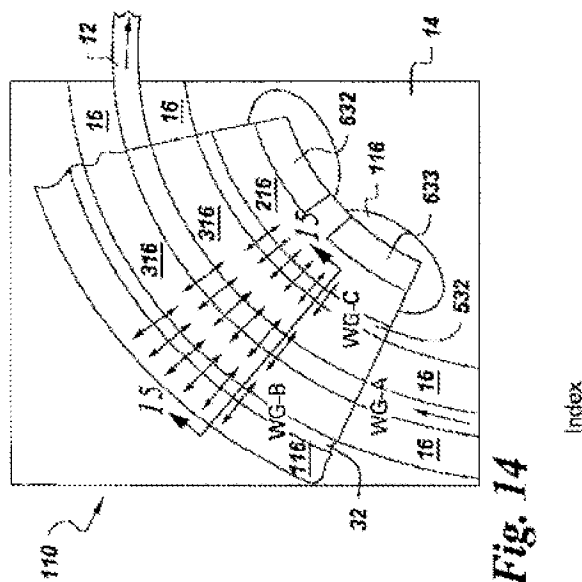
With respect to Nishimura, the Office Action states:

The aspect lacking in either primary reference is that the unexposed area would include the core and a diffusion source region. Nishimura et al is applied for reasons of record to teach this. The region directly adjacent to the unexposed area that is the core would become the diffusion source region and the index contrast region on the combination as applied. Again, it is clear that a diffusion of the monomer is occurring during the irradiation of the exposed portion in the primary references, and this diffusion would in fact form the instant diffusion source region and index contrast region. If not, applicant is requested to point out exactly what differentiates the instant diffusion source and index contrast regions from that shown in either primary reference. Either of the primary references generally teaches the instant polymer binders and polymerizable monomers.

As stated in Applicant's prior office action responses, Nishimura describes generation of a "low RI (reactive index)" area by locally generating (by photo patterning) an acid which decomposes the high RI component (A) which then must be removed from the system by volatilization. The decomposition only reduces the molecular weight of the high RI component so it can volatilize - the decomposition does not change the RI. Once volatilized, the region has less of the high RI component-A and therefore a lower RI. Decomposition itself does not change the RI of component-A or the region. The RI only decreases when component-A is removed. The degree of decomposition of component-A and resulting amount volatilized (and subsequent change in RI) probably is effected by the amount of photoacid present, and the photoacid may be able to move around (or diffuse) a bit, but decomposition/volatilization of component-A is what causes the RI change. Uncured monomers are not described or present in Nishimura's patent, and no diffusion is described as forming index contrast areas.

With respect to claims 11 and 16 and the "diffusion source regions," Applicant respectfully directs the Examiner's attention to FIGs. 14-19 which are described in paragraphs 60-65 with paragraph 60 being copied below for ease of reference:

[0060] FIG. 14 is a top view of a curved waveguide **10** core **12** and cladding **14** including index contrast regions in accordance with another embodiment of the present invention. The embodiment of FIG. 14 is designed for enhancing the amount of monomer diffusion into selected catalyst activated (exposed) areas by providing additional monomer diffusion source regions near one or both sides of a bend radius. In the embodiment of FIG. 14 one source of monomer diffusion is from core **12** itself and a second source of monomer diffusion **32** is from an unexposed region adjacent to the side cladding surrounding the core. Both sources can be fabricated simultaneously by a masking process, for example.



Diffusion source regions are described in claims 11 and 16 as being patterned in combination with the core region and are not the core regions themselves (see claim 16 for example: one portion of the unexposed area comprising the core region and another portion of the unexposed area comprising a diffusion source region). No specific reference to such diffusion source regions appears to be present in any of the cited references.

Applicant also notes the following language from the Office Action:

It is noted that the instant terms—ie, diffusion source and index contrast-- cannot be found in the primary references. However, this does not mean that the processes disclosed in these references are not in fact the basic instant process. Applicant needs to do more than state that the references do not appear to teach these regions, when in fact they do appear to be taught.

Applicant respectfully submits that, as stated above, Applicant has described and claimed diffusion source regions that are a third region in addition to the unexposed core regions and the exposed bulk regions. Applicant can find no such regions either taught or suggested in any of the applied references, whether taken individually or in combination. Nishimura does not teach or suggest such additional regions and, because Chandross and Suzuki form the core by the exposed area, such additional diffusion source regions would not be feasible with those embodiments.

Accordingly, Applicant respectfully submits that claim 1, and claims 2-8, 10-11, and 13-15 which depend therefrom, claim 16, and claims 17-32 which depend therefrom define allowable subject matter over the applied references.

Summary

In summary, Applicant respectfully requests that a timely Notice of Allowance be issued in this case. Should the Examiner believe that anything further is needed to place the application in better condition for allowance, the Examiner is requested to contact Applicant's undersigned representative at the telephone number below.

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